We convert the 0.0009 coefficient into a table showing the additive amount (in cents) for various levels of addressability. Since the coefficient relates to natural logarithms, we compute the effect at the mean of the Commission's sample of 377. This provides a straightforward implementation procedure with a very simple table (below).[11] The formula used to create the table is:

(4) **ADD-ON VALUE = exp (0.0009 PADDRES - 0.244) - exp (- 0.244)**

where

ADD-ON VALUE = **add on value in cents per channel;**
exp = **2.718 raised to the power.**

and -.244 is the mean of the natural logarithm of price per channel in the Commission's sample.[12] This add-on value is thus the difference between the model which considers addressability and the Commission's model which does not consider it. Note that the exp operator is required to convert from natural logarithm values used by the Commission in model (1) above.

The add-on formula shows that the add-on value depends on the extent of addressability in the given system. A system with 0 percent addressability yields a 0 cents per channel add on value. In contrast, a system with 100 percent addressability yields an add-on value of 7.4-cents per channel.

Procedure to implement the Benchmark Plus model

One can correct the Commission's error by first using the existing benchmark tables (or formula) and finding the appropriate value as instructed in Form 393. Then, before entering the value in Lines 121 and Line 220, add the applicable amount from the table below, depending on the percent addressability of the system. Interpolation between the different data points on this table should be accomplished following the general method discussed in the Commission's instructions in Attachment A to the benchmark tables, item 3. This combination can be referred to as the corrected benchmark value. After this calculation has been made, the corrected benchmark value would be entered in Lines 121 and Line 220 in Form 393 and the remainder of the form would be completed pursuant to the existing rules and instructions.

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11. In principle, one could create a different "add-on" effect for systems with different numbers of subscribers and channels. Our procedure cures the Commission's problem with a minimum of additional calculations required by the Commission and the cable system operator.

12. This value corresponds with a mean cents per channel of 78.3 cents.

Amount to be Added to FCC Benchmarks To Account for Percent Addressability

Percent of Subscribers Who Are Addressable	Amount Per Channel to Add to Benchmark
Value	
0	$0.000
10	$0.007
20	$0.014
30	$0.021
40	$0.029
50	$0.036
60	$0.043
70	$0.051
80	$0.058
90	$0.066
100	$0.074

Source: FCC Cable Operator June 11 Database, and ETI Regression Model

Appendix 3

Analysis of the FCC's Cable TV Productivity Offset Proposal

David J. Roddy[1]

Introduction

The Commission seeks comments on its proposal (at paragraph 85 of the Notice) to create a formula for annual price adjustments equal to the rate of change of the Gross National Product Price Index (the GNP-PI) *minus* the rate of change of 'productivity' in the cable industry. This has a potentially major financial impact and it is a separate issue from the benchmark model and the cost of service approach. The benchmark and cost of service mechanism lead, according to the FCC, to initial rates. After that point, the percent rate change would be equal to the percent change in GNP-PI minus the productivity offset. As an example, the GNP-PI for the current annual period is about 3.3 %. Suppose that the FCC adopts a productivity offset of 3.3 % as its suggests in option (3) of paragraph 85. In that case, each cable operator's price increase would be the GNP-PI increase of 3.3% minus the productivity offset of 3.3%. This would give a 0% allowed price change, no matter how much the cable operator's costs of doing business had increased.

A "productivity offset" for cable companies cannot be substantiated at this time for both empirical and theoretical reasons. Standard economic analysis shows clearly that the FCC's productivity offset concept is incorrectly applied to the cable industry for several reasons. The cable industry's cost per channel per subscriber[2] is subject to economies that either (a) are one-time in nature and thus cannot be expected to reoccur as the industry matures and/or (b) vary greatly among different operators and regions of the country. Factors that would have to be accounted for include economies of network density, economies of scale, economies of channel capacity, and other economic and financial characteristics. It is impossible for the Commission to successfully develop one (or even several) productivity offsets, because accurate and reliable data to calculate a cable industry productivity growth rate is not available to the Commission. Economists agree on the correct framework for the modern measurement of total factor productivity ("TFP") and a variety of sophisticated and

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2. Since productivity is directly related to the cost per channel, we can examine the Commission's proposal by discussing factors which influence the cost of producing cable TV services. A more direct measurement of productivity is discussed in Appendix 3.

accurate studies have been conducted in several industries.[3] The required data is just not available in the Cable TV industry.

The productivity offset applied by the Commission in telecommunications provides no guidance or support for such a program applied to the cable industry. The LEC price caps plan for these telecommunications carriers was premised on the assumption that some productivity offset could be broadly defined so as to apply to all of the large, or "Tier I" carriers. This assumption was not, of course, subjected to testing, because the Commission lacked the necessary carrier-specific data to do so. Finally, even if all of the other problems did not exist, the limited data that are available demonstrate that the cable industry's approximate "labor productivity' trend for the last 11 years is essentially zero. In other words, cable operators have been adding employees at a rate comparable to the increase in cable subscribers.[4] Thus, even if the Commission were to adopt the productivity offset concept, the available data indicate that the correct value would be zero.

Discussion

Productivity measures the relationship of outputs and inputs. Outputs are the goods and services that the companies sell to the public. Inputs are the resources that the companies use to produce the outputs. Typically, inputs are categorized as capital, labor, and materials. In this context, productivity is the increase in output which is accomplished without increasing the inputs. In the same spirit, it can be measured as the reduction in the inputs that can be accomplished without decreasing output. Overall, the general approach can be discussed with reference to costs; if productivity is increasing, costs should decrease. The modern approach to productivity measurement focuses on Total Factor Productivity ("TFP") because it is the most accurate and reliable. This approach includes all inputs in its formulation and is regarded as an advance over simpler measures such as labor productivity which uses only one of the inputs.

Thus, as a practical matter, the productivity gains available to a given cable operator can be summarized as the output growth rate (for example, the number of subscribers) *minus* the input growth rate (a measure of the labor, capital plant, and purchased materials). If a

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3. See, for example, Duke, J., D. Litz, and L. Usher, "Multifactor Productivity in Railroad Transportation", *Monthly Labor Review*, August, 1992, 49-58. The required data items include annual data for at least the last 8 years on measures of the economic concept of the capital stock, the number of employees, and purchases of materials and intermediate services. An accurate measure of the capital stock, for example, includes inflation adjusted values for past investment by asset category by year including economically correct depreciation rates, tax rates, and tax depreciation rates as well as an overall correct industry rate of return. See, for example, Hulten, C. "The Measurement of Capital", in E. Berndt and J. Triplett, eds., *Fifty Years of Economic Measurement*, Chicago: University of Chicago Press, 1990.

4. This is true even though, as the Commission observed, Cable's use of labor is relatively efficient. (*Notice,* footnote 100).

growth of 1% in the output requires a 1% growth rate in input, then the total factor productivity growth rate would be zero. In this example, if the Commission were to incorrectly assume that the operator should have, for example, 2% productivity growth, then the operator would be unfairly penalized in the annual rate adjustment because of the unique circumstances that cause inputs to increase as it gains new subscribers. In the next section, we discuss specific circumstances which would clearly describe parts of the country where customers are highly likely to be adversely impacted by the Commission's productivity offset proposal.

It is well known that many industries are subject to economies of density.[5] In such a situation, average cost is critically dependent on the density of the customers. Thus opportunities for cost reduction (and hence productivity gains) are much less available in sparse population areas. For example, in the airline industry, a large scale study concluded "The primary factor explaining cost differences is density of traffic within an airline's network."[6] With the productivity offset proposal, the Commission assumes that cable operators in all areas of the country have equivalent opportunities for productivity gains. The Commission's assumption is obviously false. In fact, the Commission's own benchmark database shows that in some areas, a gain of 100 customers could be achieved with 1 mile of cable; in other areas, a gain or 100 customers would require as much as 9 miles of cable. We refer to the database of 377 cable systems which it used in Appendix E of the Commission's *Report and Order*, MM Docket No. 92-266, released May 3, 1993. Miles per 100 Subscribers is defined as 100 times S2_MILES divided by S2_HHSUB using the Commission's variable names.

Since the areas which require 9 miles of cable per 100 subscribers would have high capital growth relative to the output gain, it would have little or no productivity gain. Thus the consumers in such areas would be penalized because the cable operators could not expand economically because of the 'productivity offset' rules and regulations implemented by the Commission.

In the cable industry penetration -- the number of cable subscribers as a percent of homes passed -- plays a large role in shaping the economies (and hence productivity) available to a given cable operator. In an area with high penetration, as defined here, it would be more difficult to gain additional subscribers. The only way to gain additional subscribers would be to build additional cable plant, if even that option is available to the operator. Thus the operator is, as in the previous section, faced with the possibility of having to increase the inputs (the capital, labor, and materials) to gain additional output (subscribers). Given the

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5. F. M. Scherer and D. Ross, *Industrial Market Structure and Economic Performance*, Third Edition, Boston, Mass.: Houghton Mifflin Company, 1990., chapter 4.

6. D. Caves, L. Christensen, and M. Tretheway, "Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ," *Rand Journal of Economics*, Vol. 15, No. 4, Winter 1984.

definition of total factor productivity as the output growth rate minus the input growth rate, operators with already high penetration would expect essentially zero percent productivity. Thus, even a modest productivity offset would discourage cable infrastructure investment in such areas.

One should not conclude that several productivity offsets could solve the problem that is raised here; the data above shows that a whole range of values would have to be adopted by size of cable operator and population density. Furthermore, the personal income growth in the operator's state would also be a factor; increasing personal income would likely make it easier to acquire additional subscribers. Thus, if the Commission were to try to adopt different productivity offsets to account for the unique circumstances of cable operators throughout the country, it would have to produce an entire 'benchmark-like' table of values to accurately represent potential productivity gains. It would also have to adjust GNP-PI to reflect regional and local differences. This is clearly impracticle.

In any event, accurate and reliable data to calculate a cable industry productivity growth rate is not available to the Commission. The correct approach to productivity measurement in the cable industry requires investigation of the total factor productivity concept. This is calculated as the output growth rate minus the input growth rate. This requires historical measures of inputs such as labor, materials, and the capital stock as well as a measure of the products and services that the industry sells to the public.[7]

Careful attention to data details is required and a realistic assessment of capitalized labor should be separated from 'expensed' labor. The modern approach to measurement of the capital stock is well-accepted among economists[8]; it requires inflation adjusted values for past investment by asset category by year including economically correct depreciation rates, corporate tax rates, as well as an overall correct industry rate of return. It should also account for asset appreciation and the tax effects of both depreciation and investment tax credits.[9] A calculation for the cable industry would have to identify, separately, different sources of economies, and differentiate one-time effects from those that could be expected to continue in the future. A productivity offset would have to account for the vast differences

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7. See the exhaustive study of some 60 industries in D. Jorgenson, F. Gollop, and B. Fraumeni, *Productivity and U.S. Economic Growth*, Cambridge, Mass.: Harvard University Press, 1987.

8. See, for example, the references in footnotes 3 and 4 above.

9. The modern economic approach to measurement of the capital stock shows the irrelevance of the Commission's unsupported reliance on Tobin's Q as a measure of market power. (See, for example, fn. 44 of the Commission's July 16 Notice.) Furthermore, the modern approach specifically acknowledges the existence and value of intangibles in the capital stock. See, for example, B. Hall, "Stock Market's Valuation of R&D Investment During the 1980's", *American Economic Review*, Vol 83, No. 2, (May, 1993) p. 259 as well as L. Weiss, "Advertising, Profits, and Corporate Taxes", *Review of Economics and Statistics*, November, 1969, p. 421.

in realizable productivity improvements in specific cable systems (to say nothing of individual franchises) due to the "lumpiness" of capital additions.

Moreover, past applications of a productivity offset program by the Commission in telecommunications provide no guidance or support for such a program applied to the cable industry. The Local Exchange Carrier (LEC) price caps program does use a productivity offset in its annual rate adjustment program for *interstate* telecommunications services. This initial price caps plan for these telecommunications carriers was premised on the assumption that some productivity offset could be broadly defined so as to apply to all of the large, or "Tier I" carriers. This assumption was not, of course, subjected to testing, because the Commission lacked the necessary carrier-specific data to do so. More recent evidence suggests that there is no single productivity offset that is applicable to all carriers in the industry. Since the overall economics of the cable industry (as partially described above) reveals that there is even more disparity than for telecommunications carriers. Thus a single productivity offset (or even several) would be totally arbitrary.

The current system of "price caps" now applied to telephone companies was developed by the FCC from several assumptions or factors. The Commission had multiple years of administering a cost of service based program of rate regulation for telephone companies. Substantial amounts of historical, time series data had been developed prior to the implementation of price caps, and telephone company price index data comparable to broader measures of national price changes had been collected for well over 40 years. The FCC assumed that a single value for annual productivity changes could be developed for at least the largest telephone holding companies. The price cap based on national average price index adjustments could be modified as needed by a limited set of "exogenous" adjustments, and the resulting product categorized according to well-defined service baskets and bands. In noting its ability to rely upon the large existing, historical data base of telephone company information, the Commission was reiterating its findings through the Price Caps proceeding.[10] The Commission also predicated the national average price caps plan on many of the uniform rules that it had developed under Title II regulation.[11]

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10. *See*, for example, the *Further Notice of Proposed Rulemaking*, 3 FCC Rcd at 3195 at paragraphs 118, 130-131 (1988). The FCC also noted, "In the LEC Price Cap Order, we found that the rates in effect on July 1, 1990, as adjusted by subsequent errata, represented a reasonable basis from which to begin price cap regulation. Those rates were the product of an annual access review process, and represented the latest set of rates shaped by an ongoing rate of return review process dating back to 1984." *Order on Reconsideration*, 6 FCC Rcd 2637 at paragraph 152 (1991), footnote omitted.

11. "In the area of LEC costs, jurisdictional separations, usage, and earnings data, we currently monitor LEC performance using two reporting systems...Based on our review of these reports and their contribution to price cap regulation, we conclude that these reports will adequately provide the information we will need to monitor price cap LECs." *LEC Price Cap Order* (CC Docket No. 87-313) 5 FCC Rcd 6786 at paragraph 373 (1990).

However, despite all of this data collected over a period of many years under a uniform system of accounts, the Commission never successfully measured Total Factor Productivity in the LEC industry. In its LEC telecommunications price caps docket, the Commission used telecommunications prices relative to inflation to measure productivity.[12] The primary weight was placed on 5 or 6 annual price values which had no relationship to a standard economic total factor productivity study.

Thus, a close and careful examination of the details of the LEC price caps program and the development of its productivity offset shows clearly that past applications of a productivity offset program by the Commission in telecommunications provide no guidance or support for such a program applied to the cable industry.

Finally, although a complete analysis of total factor productivity is not possible due to data limitations as discussed above, a rough calculation of 'labor productivity' can be made at the aggregate industry level. Cable industry data for the 1981 through 1991 time period[13] show that output (number of subscribers) grew from 23.2-million to somewhat less that 55.8-million, a growth rate of 10.5% per year. However, the growth rate of labor is 10.5% per year for the same time period, based on a change in employees from 45,351 to 106,771; therefore labor productivity (calculated as output minus labor) is zero percent per year for the last eleven years.[14] In any case, a rough calculation of labor productivity is a poor substitute for total factor productivity given the wide variation of system characteristics found in the cable television industry.

12. *Second Report and Order*, FCC CC Docket No. 87-313, Released October 4, 1990, Appendices C (Frentrup and Uretsky) and D (Spavins and Lande).

13. "Cable Television Developments", NCTA, October, 1992

14. Since the capital input growth rate is probably the same or higher, this calculation implies that a full TFP growth rate is similar to the results we show here.